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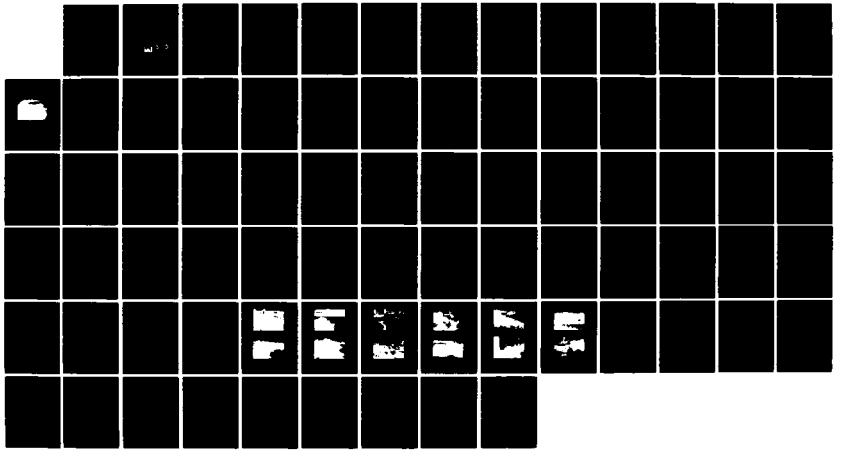
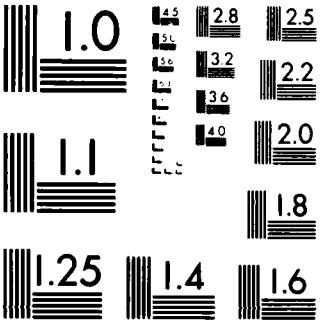
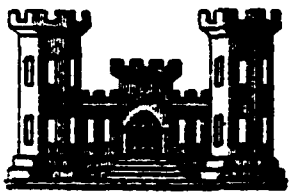




MERRIMACK RIVER BASIN
HOLDEN, MASSACHUSETTS

CHAFFIN POND DAM
MA 00621

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

FEBRUARY 1979

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DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Holden, Massachusetts
Poor Farm Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

THe dam is actually a section of roadway embankment about 135 ft. long, 11 ft. high and with a minimum width of 100 ft. It is intermediate in size with a low hazard potential. Generally the dam is in poor condition. The headwalls have experienced major structural failures and the potential for a collapse of the upstream headwall with possible obstruction of flow to the outlet does exist.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

OCT 2 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

I am forwarding to you a copy of the Chaffin Pond Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Worcester Polytechnic Institute.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MERRIMACK RIVER BASIN
HOLDEN, MASSACHUSETTS

CHAFFIN POND DAM

MA 00621

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS 02154

FEBRUARY 1979

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM

Identification No.:	MA 00621
Name of Dam:	Chaffin Pond
Town:	Holden
County:	Worcester
State:	Massachusetts
Stream:	Poor Farm Brook
Date of Site Visit:	16 November 1978

BRIEF ASSESSMENT

Chaffin Pond Dam is actually a section of roadway embankment approximately 135 ft. long, 11 ft. high and with a minimum width of 100 ft. Three submerged culvert outlets pass through the dam between upstream and downstream headwalls, allowing the water level to be the same on both sides of the dam. The control entrance to the assumed 30-in. diameter outlet on the left side has slots for stoplogs; however, none are in place. The control for a 4-ft. box culvert in the center is an open wood gate. The third outlet culvert is also gated but apparently blocked. Water from Chaffin Pond flows to outlet works at a second pond downstream from the dam where water is drawn for hydraulic research purposes.

Chaffin Pond Dam was formerly classified as having a "high" hazard potential in the Corps of Engineers National Inventory of Dams. Due to the lack of downstream development and the presence of a downstream dam controlling the water level in Chaffin Pond, the dam has been reclassified as having a "low" hazard potential in the event it were to fail.

The dam is in poor condition, based on a visual examination of the structure. The headwalls have experienced major structural failures and the potential for a collapse of the upstream headwall with possible obstruction of flow to the outlet does exist. These deficiencies require attention, but do not warrant urgent remedial action in consideration of the dam's configuration, "low" hazard potential and particular hydraulic/hydrologic aspects of the project.

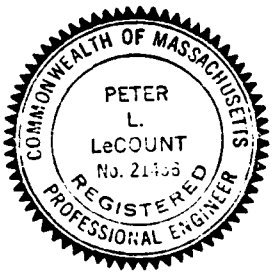
Based on the size (intermediate) and hazard potential (low) classifications in accordance with discussions with Corps of Engineers personnel, the test flood appropriate for this dam is one-fourth the Probable Maximum Flood (1/4 PMF). The capacity of the two unblocked culverts is about

300 cfs or 17 percent of the test flood inflow of 1,750 cfs (486 csm). Hydraulic analyses indicate that the test flood would surcharge the pond by 680 acre-ft. and raise the pond level to about 4.2 ft. below the top of the dam. Therefore, no overtopping would be expected. It could take as long as 24 hours or more before the pond would return to its normal level.

Worcester Polytechnic Institute, owner of the upstream headwall, should engage a registered professional engineer to evaluate the existing headwall and recommend repair or replacement. The owner of the roadway embankment should likewise have the downstream headwall and outlet culverts evaluated by an engineer, and clear all conduits through the dam. The upstream embankment slope should be maintained by whomever owns the property. The results of the investigations and remedial measures mentioned above and outlined in Sections 7.2 and 7.3, respectively, should be implemented by the various owners within one year after receipt of this report. As also recommended, a program of biennial periodic technical inspections should be instituted.

Alternatively, consideration should be given to replacing the existing outlet works with a properly designed uncontrolled culvert system as outlined in Section 7.4.

HALEY & ALDRICH, INC.
by:



Peter L. LeCount
Vice President

This Phase I Inspection Report on Chaffin Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment

of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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TABLE OF CONTENTS (Continued)

1. Overview of Chaffin Pond Dam, downstream side

FILE NO. 4270 A6

DAM: Chaffin Pond

IDENTIFICATION NO. MA 00621

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LOCATION MAP

USGS QUADRANGLE

WORCESTER NORTH, MA

APPROX. SCALE: 1"= 2000'

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM
CHAFFIN POND DAM
MA 00621

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 28 November 1978 from Colonel Max B. Scheider, Corps of Engineers. Contract No. DACW33-79-C-0018 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/electrical and hydraulic/hydrologic aspects of the Investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located near the northeast corner of Chaffin Pond in Holden, Massachusetts, as shown on the Location Map, page vii. Discharge from the dam is controlled by the outlet works at a second pond downstream, is conveyed to a third pond and finally dissipates into storm sewers and a swampy area less than 1 mi. downstream of the dam site.

b. Description of Dam and Appurtenances. Chaffin Pond Dam is actually a section of the Route 122A and Zottoli Road embankment about 135 ft. long and 11 ft. high with a minimum width of 100 ft. There is no spillway structure at the dam. Flow was intended to pass through three controlled culvert outlets through the dam. The general configuration of the project is shown on the Site Plan Sketch, page C-1.

A 50-ft. long concrete headwall on the upstream side has three submerged entrances to the outlet culverts, as shown on the field sketches, pages B-17 and D-3. The left entrance has stoplogs slots for control of the assumed 30-in. diameter culvert. The gated center entrance controls a reported 4-ft. by 4-ft. culvert. The right gated entrance controls a culvert assumed to be 30-in. in diameter. The inverts of these approximately 110-ft. long culverts are assumed to be El. 702. A field sketch of the 30-ft. long downstream headwall is shown on page B-18.

The top of the dam is considered to be about El. 713, the level of Route 122A above the outlet culverts. The pavement dips lower near the underpass of the adjacent railway embankment and the shoreline may also be somewhat lower than El. 713 to the right of the dam. The railroad embankment itself would act as a secondary dam in the event Chaffin Pond Dam were overtopped.

c. Size Classification. Chaffin Pond Dam has an estimated maximum storage of 1,450 acre-ft. and a maximum height of 11 ft. Storage of from 1,000 to 50,000 acre-ft. classifies the dam in the "intermediate" size category, according to the guidelines established by the Corps of Engineers.

d. Hazard Classification. The dam was formerly classified in the Corps of Engineers National Inventory of Dams as having a "high" hazard potential. Based on the dam failure analysis, Appendix D, the traffic on Route 122A, which connects Worcester to Holden, would be interrupted if the dam were breached. No flooding from the failure

would be expected as the water level downstream from the dam is controlled at the outlet gates of a second pond. The potential economic loss would be considered minimal and no loss of life would be expected from a failure. Consequently, the hazard potential classification has been reduced to "low" category.

e. Ownership. There is apparently multiple ownership of the dam. The name and address of the owner of the upstream headwall of the dam is:

Alden Research Laboratory
Worcester Polytechnic Institute
30 Shrewsbury Street
Holden, MA 01520

Worcester Polytechnic Institute has owned the strip of land on which the gates are built since 1970 and the flowage rights to Chaffin Pond since 1894.

There are additional owners responsible for other portions of the dam. According to Mr. Al Berg, Holden Town Engineer, the State owns and maintains Route 122A and the Town of Holden owns Zottoli Road. Both roadway embankments are considered part of the dam. There may also be other owners of the upstream embankment slope adjacent to the strip of land owned by Worcester Polytechnic Institute, further complicating the ownership of the dam.

f. Operator. Mr. Joseph J. Mielinski, Manager of Operations, Alden Research Laboratory, is responsible for the operation, maintenance and safety of the upstream headwall portion of the dam. His phone number is (617) 829-4323.

g. Purpose. The dam currently serves only as a roadway embankment, since the outlet gates are open and the level of Chaffin Pond is controlled at a second pond further downstream. Water is drawn from the second pond for hydraulic research purposes by the owner.

h. Design and Construction History. The dam is believed to have been constructed prior to 1900, coincidental with the construction of the roads. However, there are no available records of the design and construction history.

i. Normal Operational Procedures. There were no formal or informal operational procedures disclosed for Chaffin Pond Dam. The owner reported that the dam gates have not been operated for at least ten years.

1.3 Pertinent Data

All elevations reported herein are based on field measurements correlated with elevations appearing on the USGS Worcester North Quadrangle, which is based on Mean Sea Level (MSL) datum.

a. Drainage Area. An approximate breakdown of land usage in 3.6 sq. mi. watershed of Chaffin Pond Dam is shown below:

	Area	
	Acres	% of Total
Developed	700	30
Water Surface	130	6
Wooded	1,450	64
TOTAL:	2,280	100

The contour of the terrain is, in general, rolling with occasional steep slopes near fringes of the drainage area.

b. Discharge at Dam Site

1. Outlet Works..... 3 culverts at invert El. 702 (Approx.)
2. Maximum known flood at dam site..... Unknown
3. Ungated spillway capacity at top of dam..... Not applicable
4. Ungated spillway capacity at test flood elevation..... Not applicable
5. Gated spillway capacity at normal pool elevation..... Not applicable
6. Gated spillway capacity at test flood pool elevation..... Not applicable
7. Total spillway capacity at test flood pool elevation..... Not applicable
8. Total project discharge at test flood pool elevation..... 300 cfs at El. 708.8

c. Elevation (ft. above MSL)

1. Streambed at centerline of dam..... 702

2.	Maximum tailwater.....	Unknown
3.	Upstream portal invert diversion tunnel.....	Not applicable
4.	Recreation pool.....	705 to 706
5.	Full flood control pool.	Not applicable
6.	Spillway crest.....	Not applicable
7.	Design surcharge - original design.....	Unknown
8.	Top of dam.....	713 (Top of Rt. 122A)
9.	Test flood design surcharge.....	708.8

d. Reservoir

1.	Length of maximum pool...	1.1 mi.
2.	Length of recreation pool.....	1.0 mi.
3.	Length of flood control pool.....	Not applicable

e. Storage (acre-feet)

1.	Recreation pool.....	310
2.	Flood control pool.....	Not applicable
3.	Spillway crest.....	Not applicable
4.	Top of dam.....	1450
5.	Test flood pool.....	680

f. Reservoir Surface (acres)

1.	Recreation pool.....	100
2.	Flood control pool.....	Not applicable
3.	Spillway crest.....	Not applicable
4.	Test flood pool.....	150
5.	Top of dam.....	230

g. Dam

1.	Type.....	Earthen fill (mostly roadway embankment)
2.	Length.....	Approx. 135 ft.
3.	Height.....	11 ft.
4.	Top width.....	100 ft. (min.)
5.	Side slopes.....	Varies from 3-5H to 1V U/S; vertical headwalls U/S and D/S
6.	Zoning.....	Unknown
7.	Impervious Core.....	Unknown
8.	Cutoff.....	Unknown

9. Grout curtain..... Unknown

h. Diversion and Regulating Tunnel. Not applicable.

i. Spillway. There is no spillway at the dam. Discharge is through the culvert outlets into a downstream pool of water between the dam and the railroad embankment. The water level of the pond is controlled by the outlet works at the pond immediately downstream of the railroad embankment (see sketches, pages B-19 and B-20).

j. Regulating Outlets. According to an inspection report dated 9 April 1973, page B-16, there were two 30-in. diameter culverts and one 4-ft. box culvert constructed to convey water through the dam. The outlets were designed to be controlled by the two single-stem timber gates at the middle and right culvert and stoplogs at the left culvert. The gates were manually operated utilizing a rack and pinion device. However, they are now badly deteriorated and what is left of each is in the open position. The right culvert appears to be blocked by siltation. The stoplogs for the left culvert are not in place.

At present, discharge appears to be through two uncontrolled culverts whose inverts are estimated to be at El. 702. The third conduit (on the right side) is apparently blocked.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No design data for the original dam were located and none are believed to exist.

2.2 Construction Data

No construction data for the dam were located and none are believed to exist.

2.3 Operation Data

The owner's representative does not keep any operation records for the dam and stated the control facilities have not been used for at least ten years. A statement regarding the presence of stoplogs at the outlet structure appears only in one prior inspection report dated 27 December 1940.

2.4 Evaluation of Data

a. Availability. A detailed list of the engineering data available for use in preparing this report can be found on page B-1. Selected documents from the list are also included in Appendix B.

b. Adequacy. There was a lack of engineering data available to aid in the evaluation of Chaffin Pond Dam. This Phase I assessment was therefore based primarily on visual examination, approximate hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement.

c. Validity. The information contained in the engineering data may generally be considered valid. However, the outlet works were submerged at the time of the site visit, such that the size of the culverts reported in prior inspection reports could not be confirmed.

SECTION 3 - VISUAL EXAMINATION

3.1 Findings

a. General. The Phase I visual examination of the Chaffin Pond Dam was conducted on 16 November 1978.

In general, the project was found to be in poor condition. Major deficiencies which require correction were noted.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. Saplings, heavy brush, but only occasional rock slope protection are present on the upstream slope within 60 ft. left of the headwall, Photos No. 2 and 3. The slope above the headwall is bare and has moved laterally outward, as evidenced by the condition of the headwall described in Section 3.1c.

The upstream slope right of the concrete headwall is shown in Photos No. 4 and 5. Although the brush is heavy in this area and a paved drainage ditch was provided, erosion of the slope is occurring. The sloughed soils are encroaching on the pond where the cattails are growing and blocking the entrance to the right outlet conduit. There was no upstream rock slope protection present right of the headwall.

The crest of the dam, Photos No. 6 and 7, is the paved roadways of Route 122A and Zottoli Road. The Route 122A pavement has minor cracks on the upstream side but is generally in good condition. There is a long crack at the contact between the two roadways. The asphalt paving behind the headwall which forms the downstream face is broken and cracked, Photo No. 8. A 12-in. diameter void in the pavement behind the downstream fieldstone wall, Photo No. 9, indicates loss of fines from beneath the roadway, probably through the joints of the wall. There was no indication of seepage.

c. Appurtenant Structures. The concrete upstream headwall for the outlet conduits, Photos No. 10 and 11, is in very poor condition. There is a very severe horizontal crack along the major portion of the headwall approximately 3.5 ft. from the top. The portion of the wall above the crack has moved outward 5 to 6 inches and is severely tilted. There are two major vertical cracks.

in the headwall between the left and the middle culverts. A large piece of concrete has broken off where the vertical and horizontal cracks intersect, exposing the reinforcement.

There are stoplog guides at the left culvert but no logs in place. The middle conduit has a wooden sluice gate which is open and is deteriorated to a very poor condition. The gate is obviously not operable due to its very poor condition. The right culvert gate is completely deteriorated and the lifting mechanism has been removed.

The downstream headwall of the dam, 20-ft. of concrete wall and 10-ft. of grouted fieldstone wall, is in poor condition. The concrete portion of the wall, Photo No. 8, has a major vertical crack with a large piece of concrete broken off the bottom. Settlement was apparent in the middle of the wall at the crack and the wall is tilted. The joints of the fieldstone wall at the interface with the concrete wall have deteriorated, Photo No. 9, creating voids in the joints. The middle and left culvert outlets are partially silted in while the right culvert is completely blocked with silt. Verification of the culvert sizes was impossible due to the amount of silt and submerged condition of the culvert inlets and outlets.

d. Reservoir Area. The terrain around Chaffin Pond is generally wooded and rolling. There appears to be no significant probability that landslides into the reservoir would cause waves which would overtop the dam. The eroding earth slope right of the upstream headwall is contributing to sedimentation in the pond.

e. Downstream Channel. Water from the reservoir flows through the existing outlet culverts into a small pool between Route 122A and the railroad, Photo No. 12. The basin is about 30-ft. wide and about 70-ft. long and its area is apparently being reduced from filling operations by an adjacent business. An 8-ft. diameter arch culvert underneath the railroad conveys the flow from the basin into a second pond, which extends from the railroad embankment to Shrewsbury Street. The outlet facilities at this pond, Photo No. 13, are operated by the Alden Research Laboratory. A study of the USGS quadrangle sheet indicates that the culvert underneath the railroad is the only passage for excess water from Chaffin Pond up to about El. 720.

3.2 Evaluation

Based on the visual examination conducted on 16 November

1978, the Chaffin Pond Dam project is considered to be in poor condition. It was quite apparent that the headwalls have experienced major structural failures and cannot be considered structurally adequate. The potential for a collapse does exist for the upstream headwall with possible impediment of flow to the outlets. One outlet is blocked and another has an inoperable gate. The remedial measures outlined in Section 7.3 should be implemented to correct the noted deficiencies in the dam embankment, headwalls and outlet works.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

In general, there are no formal procedures to provide routine maintenance and satisfactory operation of the dam.

4.2 Maintenance of Dam

There are no established procedures or manuals for periodic inspection and maintenance of the dam. The upstream embankment slope does not appear to have received any recent maintenance.

4.3 Maintenance of Operating Facilities

The operating facility appears to have received little to no maintenance for some time. The condition of the upstream headwall and recommended renewal of the controls are noted in an inspection report dated 4 June 1965, p. B-9 ; the reported conditions are similar to present conditions. There is no known plan to operate and maintain this facility.

4.4 Description of Any Warning System in Effect

There is no warning system or emergency preparedness plan in effect for this structure.

4.5 Evaluation

The owner should prepare an operations and maintenance manual for the dam. The manual should delineate the routine operational procedures and maintenance wor to be done on the dam to provide satisfactory operation and minimize deterioration of the facility.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. The earthfill dam is a part of the Route 122A embankment. The dam does not have a spillway section. Flows from Chaffin Pond Dam are conveyed into a second pond through the existing outlets. Since the capacity of the outlets appears to be limited, a significant surcharge in the pond is expected following a storm.

b. Design Data. No hydrologic or hydraulic design data were available for this dam site.

c. Experience Data. As stated in prior inspection reports, page B-2 and B-4, the outlet gates were sand bagged during the 1938 flood and the water level in the pond was left to rise for 18 hours. A surcharge of about 3-ft. was experienced without any damage and route 122A was not overtopped.

d. Visual Observations. The water surface elevation in the pond on the day of inspection was about 4.5 ft. below the top of the headwall and 8 ft. below the road surface, which is considered to be the top of the dam.

There are three rectangular outlets located at the concrete headwall. The left outlet was provided with slots for the insertion of stoplogs; however, no stoplogs were present on the day of inspection. The gate in the center was apparently broken, and although it was submerged, an opening through it was detected. Further checking of the downstream end, however, did not indicate a significant flow through this outlet. The right outlet was completely blocked by silt and grass growth in front of the gate at the upstream end.

The dam and outlet works, in their present condition, appear to have been abandoned or left for a gradual deterioration. The pool of water downstream of Route 122A was subject to siltation, overgrown by vegetation and partially filled behind the adjacent business on the right.

e. Test Flood Analysis. Based upon the Corps of Engineers guidelines, the recommended test flood for the size "intermediate" and the hazard potential "low" is within the range of 1/4 to 1/2 PMF (Probable Maximum Flood). The PMF was determined using Corps of Engineers guidelines

for "Estimating Maximum Probable Discharges" in Phase I Dam Safety Investigations. The watershed terrain was determined to be "rolling" and an inflow rate of 1950 csm was selected for the drainage area of 3.6 square miles. This would result in a test flood inflow of about 1750 cfs, using a test flood of 1/4 PMF, which is judged to be appropriate for this project.

The capacity of the center and left culverts of the existing outlet facilities is about 300 cfs, or 17 percent of the test flood; therefore, most of the flood flow would surcharge the reservoir. The results of the preliminary analysis showed that the reservoir volume, after a storm of the magnitude of the test flood, would increase by about 680 acre-ft., and the water surface would rise to El. 708.8. This elevation would still be 4.2 ft. below the top of the dam, but it could take as long as 24 hours or more to bring the reservoir back to its normal level, depending on the condition of the outlet facilities at the time of the flood.

f. Dam Failure Analysis. Based on Corps of Engineers Guidelines for Estimating Dam Failure Hydrographs and assuming that a failure would have occurred along the 100-ft. long section at the mid-height of the dam, the peak failure outflow is estimated to be 2,300 cfs. However, this is true only in the theory because there is no channel downstream from the dam to carry this flow. The downstream flow area is restricted at a short distance from the dam by the railroad embankment, the local topography, and by the outlet controls in the second pond.

It is assumed that the water surface in Chaffin Pond at the time of the failure would be at El. 713.0, which corresponds to the top of Route 122A. This means that a surcharge volume of about 1240 acre-ft. would have to be emptied through the culvert underneath the Providence and Worcester Railroad and through the outlet facilities at the second pond downstream in front of Alden Research Laboratory. Traffic would be interrupted on Route 122A until the breach is repaired. A preliminary flood routing through the second pond indicated that Shrewsbury Street would be overtopped by about 1 ft. of water for a period of about 1 hour. Similar studies also showed that it would take approximately 40 hours to discharge the excess water out of the system.

No loss of life or major property damage is expected from a failure of the dam. Route 122A and Zottoli Road would have to be temporarily rerouted. Traffic on Shrewsbury Street would probably be interrupted and inconveniences would occur in the operation of the outlet facilities of the downstream pond.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. As described in Section 3, there was visual evidence that the upstream slope of the embankment has moved laterally and is sloughing from erosion right of the headwall. There is also some settlement and cracking of the pavement near the downstream headwall. Despite these deficiencies, the embankment has overall structural stability due to the fact that its width (100 ft.) is almost ten times greater than its height (11 ft.).

The headwalls for the dam have experienced major structural failures and are not structurally sound.

b. Design and Construction Data. No original design or construction data are known to exist for the embankment and the outlet works. The assessment of the dam for structural stability is therefore based on visual observations. Since the outlet conduits were submerged and could not be visually examined during the site visit, the stability of these structures is unknown.

c. Operating Records. No operating records are known to exist.

d. Post-Construction Changes. No post-construction changes are known to have occurred. If Zottoli Road was constructed before or after Route 122A, the outlet culverts have been extended.

e. Seismic Stability. Chaffin Pond Dam is located in Seismic Zone 2 and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination of Chaffin Pond Dam revealed that the project is in poor condition. The headwalls of the dam have experienced major structural failures and the potential for collapse does exist for the upstream headwall with possible obstruction of flow to the outlets. These deficiencies require attention, but do not warrant urgent remedial action in consideration of the dam's configuration, "low" hazard potential and the particular hydraulic/hydrologic aspects of the project.

Based on the results of computations included in Appendix D and described in Section 5, the 1/4 PMF test flood inflow of 1,750 cfs (486 csm) would surcharge the pond considerably but not overtop the dam. Since the capacity of the two unblocked culverts is estimated to be only 300 cfs (17 percent of the test flood), it could take as long as 24 hours or more before the pond would return to its normal level.

b. Adequacy of Information. This evaluation is based primarily on visual examination, approximate hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. Generally the information available or obtained was adequate for the purposes of Phase I assessment. However, additional information regarding the condition of the headwalls and outlet culverts which were submerged at the time of the visual examination is needed as outlined in Section 7.2.

c. Urgency. The recommendations for additional investigation and remedial measures outlined in Section 7.2 and 7.3, respectively, should be undertaken by the various owners and completed within one year after receipt of this report.

d. Need for Additional Investigation. An additional investigation should be performed by the owner or owners of the headwalls as outlined in Section 7.2.

7.2 Recommendations

It is recommended that the various owners be identified and that they engage a registered professional engineer to perform an

investigation of the condition of the headwalls and the culverts, and recommend repair and/or areas of reconstruction necessary to provide structurally stable walls on the upstream sides of the dam and properly functioning culverts.

The owners should then implement the corrective work recommended in this engineering investigation.

7.3 Remedial Measures

The dam is considered to be in poor condition, and it is considered important that the following items be accomplished.

a. Operation and Maintenance Procedures. The following remedial work should be undertaken by the appropriate owners:

1. Trim brush and trees on the embankment slopes, establish and maintain growth of grass, and control drainage to avoid local erosion by concentrated runoff which could block or partially block outlets.

2. Clear all conduits through the dam, including their entrances and outlets of silt and debris.

The operator should prepare an operations and maintenance manual for the dam. The manual should include provisions for biennial technical inspection of the dam and for surveillance of the dam during periods of heavy precipitation and high reservoir water levels. It should also delineate the routine operation procedures and maintenance work to be done on the dam to ensure satisfactory operation and to minimize deterioration of the facility.

7.4 Alternatives

An alternative to the recommended repair or reconstruction of the headwalls and outlet conduits, and the operational procedures, would be to install sufficient uncontrolled culvert capacity at the site to pass the design flood. Since the downstream dam is currently controlling the normal water level at Chaffin Pond, hydraulic and hydrologic analyses would be required for this alternative to determine the consequences of a loss of the flood retarding action of Chaffin Pond Dam.

APPENDIX A - INSPECTION CHECK LIST

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

Dam: Chaffin Pond

Date: 16 November 1978

Time: 0730-1000

Weather: Clear and cool (40's F)

Water Surface Elevation Upstream: El. 705 (8.0 ft. below top of dam, Route 122A)

Stream Flow: Very slight

Inspection Party:

Richard P. Stulgis	- Soils/Geology
Richard A. Brown Haley & Aldrich, Inc.	
A. Ulvi Gulbey	- Hydraulic/Hydrologic
Joseph E. Downing	
Robert P. Howard	- Structural/Mechanical
Frank E. Luttazi Camp, Dresser & McKee, Inc.	

Present During Inspection:

Joseph J. Mielinski; Manager of Operations
Al Ferron, Lead Engineer
Alden Research Laboratory, Worcester Polytechnic Institute

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Chaffin Pond DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	El. 713, top of Route 122A, 3.5 ft. above top of upstream (U/S) headwall
Current Pool Elevation	4.5 ft. below top of U/S headwall
Maximum Impoundment to Date	Unknown
Surface Cracks	3 to 4 ft. long cracks in pavement perpendicular to U/S headwall alignment, typically 5 to 6 ft. spacing
Pavement Condition	Generally good
Movement or Settlement of Crest	None apparent
Lateral Movement	Outward tilting of U/S headwall
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Erosion around U/S headwall, pavement cracking and settling above D/S headwall
Indications of Movement of Structural Items on Slopes	Traffic barriers tilted above U/S headwall, possible due to lateral movement
Trespassing on Slopes	Foot traffic on U/S slope above headwall
Animal Burrows in Embankment	None observed
Vegetation on Embankment	One tree and exposed slope above U/S headwall; brush and trees on remainder of U/S slope
Sloughing or Erosion of Slopes or Abutments	Surface erosion above and around U/S headwall and right U/S slope due to runoff
Rock Slope Protection - Riprap Failures	Discontinuous rip-rap on lower U/S slope area along shoreline 60 ft. left of headwall
Unusual Movement or Cracking at or near Toes	Outward tilting of U/S headwall
Unusual Embankment or Downstream Seepage	None observed. Noted 12-in. diameter void in pavement adjacent to D/S headwall; possible infiltration of soil through joints in D/S headwall

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Chaffin Pond DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
Piping or Boils	None observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation Systems	None
OUTLET WORKS - APPROACH CHANNEL AND UPSTREAM HEADWALL	
a. Approach Channel	Not applicable. Discharge is directly from the pond
b. Upstream Headwall	Refer to field sketch, page B-17
Condition of Concrete	Concrete headwall is in very poor condition. There are very severe horizontal and vertical cracks in the wall. The top 3.5 ft. of wall was moved 5 to 6 in. upstream and is tilting severely. A large piece of concrete has broken off at the intersection of the major vertical crack exposing the reinforcing.
Condition of Gates	The middle conduit has a wooden sluice gate which is open and in very poor condition. The right conduit is completely silted in and the wooden sluice gate is completely destroyed
Stop Logs and Slots	Stoplogs for the left conduit are not in place
OUTLET WORKS - DOWNSTREAM HEADWALL	Refer to field sketch, page B-18
General Condition of Concrete	General condition of the headwall is very poor. The concrete wall is badly cracked, settled in the middle and is tilting downstream
Rust or Staining	None observed
Spalling	Concrete spalled off at major crack
Erosion or Cavitation	Observed in field stone wall

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Chaffin Pond DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
Visible Reinforcing	None observed
Any Seepage or Efflo-rescence	None observed
Condition at Joints	There are large voids in the grouted joints of the field stone wall portion. Pavement behind the wall is broken and cracked. Void developing beneath the pavement behind the field stone wall
Drain Holes	None observed
Channel (Stilling Basin)	Right conduit completely silted in middle and left conduit partially silted in
Loose Rock or Trees Overhanging Channel	None observed
Condition of Discharge Channel	Submerged - not visible

FILE NO. 4160

APPENDIX B - ENGINEERING DATA

LIST OF AVAILABLE DATA
CHAFFIN POND DAM

Document	Contents	Location
County inspection reports	8 reports from 15 November 1924 through 14 March 1969	Office of the County Engineer, Room 101, Court House, 2 Main Street, Worcester, MA 01608 (pages B-2 and B-10)
State inspection report	Report dated 9 April 1973	Mass. Department of Environmental Quality Engineering, Division of Waterways, 100 Nashua Street, Boston, MA 02114 (pages B-11 to B-16)
Field sketches	Outlet facility and downstream controls made on 16 November 1978	Camp, Dresser & McKee, Inc. One Center Plaza, Boston, MA 01208 (pages B-17 to B-20)

TOWN OR CITY Holden | DECREE NO. | PLAN NO. | DAM NO 21-17

LOCATION State Highway | C. C. DOCKET NO.

DESCRIPTION OF DAM

Type State Highway Emb. El. 100'
Length
Height 10'
Thickness top 32'
" bottom
Downstream Slope 1½ : 1
Upstream " 1½ : 1
Length of Spillway
Size of Gates 1 - 4X5, 3X4 gates only.
Location of Gates
Flashboards used None
Width Flashboards or Gates
Dam designed by
" constructed by
Year constructed

GENERAL REMARKS

Owner: Worc Polytechnic Institute
Foundation: Rocky gravelly soil
Leakage: None
Condition: Good
During 1938 Flood, Gates sand bagged: water held back for 18 hours - 300. second ft came into pond.

Inspected: Nov. 15, 1924 - L.O. Marden

DESCRIPTION OF RESERVOIR & WATERSHED

Name of Main Stream Above Wor. Poly. Chaffin Pond
" " any other Streams
Length of Watershed
Width " "
Is Watershed Cultivated
Percent in Forests
Steepness of Slope
Kind of Soil Rocky - Gravelly Soil
No. of Acres in Watershed 4.08 Sq. M. 2688.
" " " Reservoir 27.
Length of Reservoir
Width " "
Max. Flow Cu. Ft. per Sec.
Height Flashboards-Low Water
" " " High "

GENERAL REMARKS

Inspected: Oct. 5, 1938 - L.H. Spofford
" : Dec. 27, 1940. " "
" : Dec. 7, 1942. L.O.M. & J.F.C.
Jan 7, 1953 - H Spofford

Decree No. Dam No. 21-17

COUNTY OF WORCESTER, MASSACHUSETTS
OFFICE OF COUNTY ENGINEER

Neg. Nos.

INSPECTION OF DAMS, RESERVOIR DAMS AND RESERVOIRS

Town Holden Date Nov. 16, 1954 Dam No.
Location State Highway above Mor Poly Tech Name of Pond or Stream
Inspected by L.S. Gordon
Owner Use Storage
MATERIAL & TYPE State Highway Embankment

Elevations in feet: above (+) or below (-) full pond or reservoir level.

FOR DAM Bed of stream below 20+- top of spillway gates only
FOR RESERVOIR
top of dam 100.4 top of flashboards ground surface below
level of overflow pipe length in feet
width top in feet 32-- width bottom in feet size pipe to mill
inches length spillway in feet head in feet
Size of wheel H. P. developed
Size of gates 4x5 3x4 location of gates
Foundation and details of construction rocky gravelly soil
condition of embankment good
Constructed by date
Designed by location
Recent repairs and date none
Evidence of leakage none
Condition good
Topography of country below
Nature of buildings and roads below dam

No. Acres in watershed No. Acres in pond
Plans secured Percent watershed in cultivation
Percent in forests Note: Cross out word not applicable
1½:1 slopes up and downstream

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by L. H. Spofford Date 10-5-38 Dam No. 21-17

Town Holden Location Chaffins Pond

Owner Worc. Polytechnic Institute Use

Earth embankment. Highway embankment. Good concrete head wall, 50ft. long

SPILLWAY = concrete flume 3½' x ? with granite block

El.top abutment El.Crest El.Apron El.Ct.Bed

Width top Abut. Width top Crest Width bottom Sp.way

Width flashboards Kind Flashboards

El.Flowline Cleanout Pipe Size and Kind Pipe

Kind of Foundation under Spillway

Condition From all appearance the flood raised the level of the pond about 3' over normal. No damage resulted. Passage under the R.R. is by means of a stone arch culvert ±7 ft. wide.

EMBANKMENT

El. Top El.Natural Ground Width Top

Width of Borrom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES 1-3x3 & 1-5x? both manually operated with rack & pinion - both closed now Location

Size Kind El.Flowline

Condition good

Evidence of Leaks in Structure

Recent Repairs and Date

Number Acres in Pond Drainage Area in Sq. Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams. and Reservoirs.

Inspected by A. H. Ingalls Date Dec 27 '40 Dam No. 21-17

Town Holden Location Chaffins Pond

Owner W P I Use Swimming

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried on crest below Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Consists of flash board notch - boards on crest 12" above W.

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Good - Used Highway

GATES 2 Location Embankment

Size Kind Rack & Pinion El. Flowline

Condition Good - both gates cracked open and Turbine water flow thru slats - W about normal.

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by LOM JFC Date 12-7-92 Dam No. 21-17

Town Holden Location Chaffin

Owner Alden Hydraulic Lab Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Ok

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Ok

GATES Location

Size Kind El. Flowline

Condition Ok

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure none visible

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

TOWN Holden DAM NO. 21-17

LOCATION Chaffins Pond STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Mass Electric Co. PLACE USE Impounding

INSPECTED BY H Spencer DATE 10-52

TYPE OF DAM CONDITION

SPILLWAY

FLASHBOARDS IN PLACE None RECENT REPAIRS None

CONDITION Good

REPAIRS NEEDED None

EMBANKMENT

RECENT REPAIRS None

CONDITION Good

REPAIRS NEEDED None

GATES

RECENT REPAIRS None

CONDITION Good - 2 Rack & Pinion Gates

REPAIRS NEEDED

LEAKS

HOW SERIOUS None

DATE

COUNTY ENGINEER

TOWN _____ DAM NO. _____

LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by _____ Place _____ Use _____

Inspected by _____ Date _____

Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition _____

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Holden DAM NO. 21-17

LOCATION on the State Highway Rte 122A STREAM Chaffin Brook

"Chaffins Pond"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by [illegible] Place Holden Use _____

Inspected by [illegible] Date [illegible]

Type of Dam Highway embankment Condition Poor to good

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition No spillway in this structure

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition The highway embankment is good

Repairs Needed _____

GATES

Recent Repairs The timbers at the gates should be renewed

Condition The concrete headwall is badly cracked

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

Holden — On Rte 122A — 21-17

Mar. 14, 1959 (D.P.P.). — "Chaffins Pond".

Owned by - U.P.C.

All flashboards have been removed.

The concrete wall is badly cracked.

-2 old gates are open at all times.

- These gates should be renewed

Poor condition

Recvd Div of W.W 1-30-74 FILE 269

1

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town HOLDEN Dam No. 3-14-134-17

Name of Dam CHAMPION POND Inspected by DiCICCO & VULCANO

Date of Inspection 4-9-79

2. Owner/s: per: Assessors _____ Prev. Inspection ✓

Reg. of Deeds _____ Pers. Contact _____

1. WORC. POLY TECH. INST c/o HOLDEN HYDR. LAB. 30 SHREWSBURY ST. HOLDEN
   Name St. & No. City/Town State Tel. No.

2. _____
   Name St. & No. City/Town State Tel, No.

3. _____
   Name St. & No. City/Town State Tel. No.

3. Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name: St. & No.:

City/Town: State: Tel.No.:

4. No. of Pictures taken NONE

5. Degree of Hazard: (if dam should fail completely)*

1. Minor _____ 2. Moderate _____

3. Severe _____ 4. Disastrous _____

* This rating may change as land use changes (future development)

6. Outlet Control: Automatic _____ Manual ✓

Operative ✓ yes; _____ No.

Comments: WATER level controlled by flashboards at spillway.

7. Upstream Face of Dam: Condition:

1. Good _____ 2. Minor Repairs ✓

3. Major Repairs ___ 4. Urgent Repairs ___

orComments: see #12

8. Downstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs ✓

3. Major Repairs ____ 4. Urgent Repairs _____

Comments: see # 12

9. Emergency Spillway: NONE

Condition: 1. Good _____ 2. Minor Repairs _____

3. Major Repairs ____ 4. Urgent Repairs _____

Comments:

10. Water Level at time of inspection: 7 ft. above ____ below ✓

top of dam ✓ principal spillway _____

other _____

11. Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment YES

Animal Burrows and Washouts NONE

Damage to slopes or top of dam YES

Cracked or Damaged Masonry YES

Evidence of Seepage NONE

Evidence of Piping NONE

Erosion NONE

Leaks NONE

Trash and/or debis impeding flow YES

Clogged or blocked spillway NO

Other _____

DAM NO. 3-14-134-17

12. Remarks & Recommendations: (Fully Explain)

THIS DAM IS AN EARTH EMBANKMENT 135' LONG COMPOSED OF ROADWAY RT. 122A. THERE IS A HEADWALL 50' LONG 13' 1 FOOT WIDE WITH ONE GATE 4X4 PRECAST CONCRETE IN CENTER OF HEADWALL AND ONE GATE AT SOUTHERLY END 30" RC. PIPE GOING INTO A 30" CMP PIPE. THESE GATES ARE OPEN AND IN POOR CONDITION. THE NORTHERLY END GATE IS PERMANENTLY CLOSED WITH THE SCREW REMOVED. THERE IS A 30" R.C. PIPE GOING INTO A 2'x2' STONE 130' CULVERT. THERE IS A CRACK 13' FROM THE NORTHERLY END OF HEADWALL CAUSING THE BALANCE OF THE HEADWALL TO BE PUSHED .1 OF A FOOT TOWARDS THE POND. THIS IS BEING FORCED BY THE EARTH PRESSURE FROM TRAFFIC ON RT. 122A. THERE IS BRUSH ALONG THE DAM THAT SHOULD BE CLEARED ALSO THE OUTLET PIPES ARE PARTIALLY BLOCKED. THIS DAM IS SAFE AND COULD BE TAKEN CARE OF WITH MINOR REPAIRS.

This appears to be copied from county report of a prev. inspection !!!!!

13. Overall Condition:

1. Safe ✓
2. Minor repairs needed ✓
3. Conditionally safe - major repairs needed _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)

   Recommend removal from inspection list _____

BOSTON COPY

DESCRIPTION OF DAM

DISTRICT 3

Submitted by PACIELLO & MULCAHY Dam No. 7-141-124-17

Date 4-9-73 City/Town HALIFAX

Name of Dam CHAFFINS

1. Location: Topo Sheet No. 7330

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year built: _____ Year/s of subsequent repairs _____

3. Purpose of Dam: Water Supply _____ Recreational _____

Irrigation _____ Other ✓

4. Drainage Area: 3.96 sq. mi. _____ acres

5. Normal Ponding Area: 115± acres; Ave. depth _____

Impoundment: _____ gals.; _____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir

1 HOME CAMARE i.e. summer homes, etc. GAS STATIONS

7. Dimensions of Dam: Length 135' Max. Height 9'

Slopes: Upstream Face 2:1 AND VARIOUS

Downstream Face VERTICAL

Width across top VARIES 40'-50'-70'

8. Classification of Dam by Material:

Earth ✓ Conc. Masonry ✓ Stone Masonry _____

Timber _____ Rockfill _____ Other _____

9. A. Description of present land usage downstream of dam:

50 % rural; 50 % urban.

B. Is there a storage area or flood plain downstream of dam which could accomodate the impoundment in the event of a complete dam failure? yes ✓ no _____.

DAM NO. 3-14-134-17

10. Risk to life and property in event of complete failure.

No. of people 150±.

No. of homes -.

No. of Businesses 4.

No. of industries 11. Type _____

No. of utilities 5. Type _____

Railroads " (B+H).

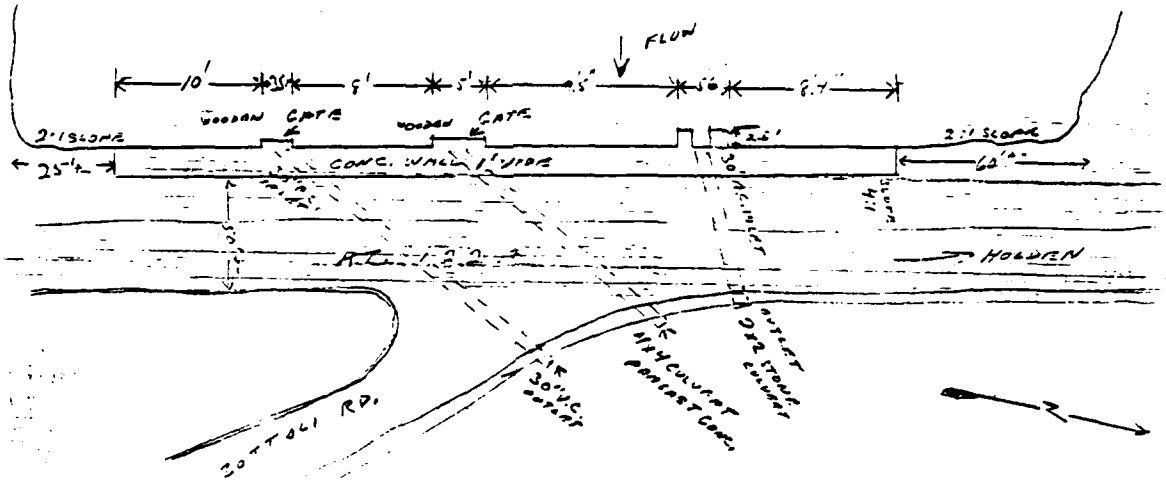
Other dams 3-14-134-15, 16.

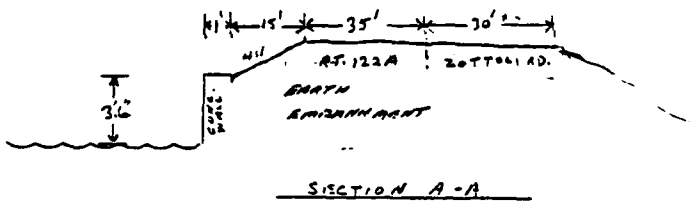
Other Aldx Research LAB (H.P.I.).

11. Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

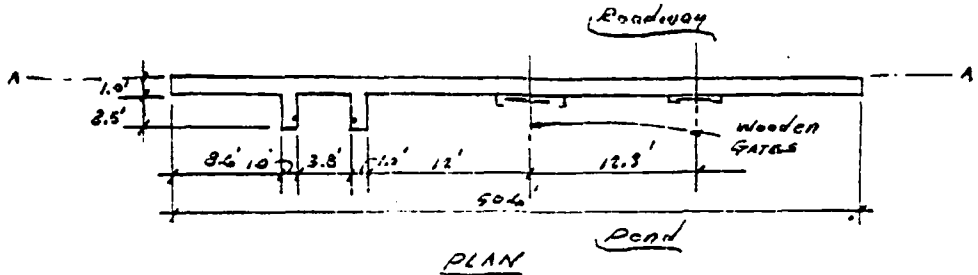
12. How to Locate: AT THE INTERSECTION OF RT. 108 & ZOTTOLI RD.

HOLDEN
CHAFFIN POND
3-14-134-17
4-9-93

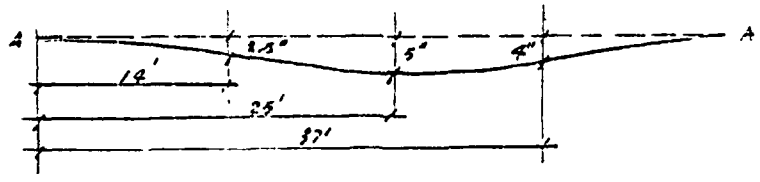




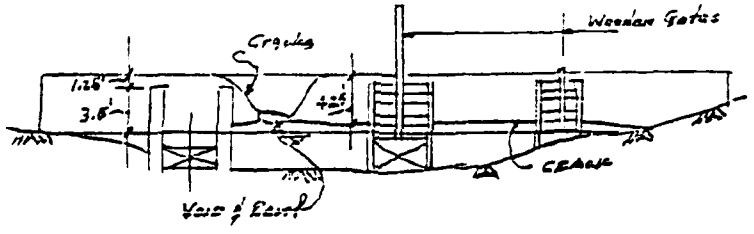
SECTION A-A



PLAN



OFFSETS

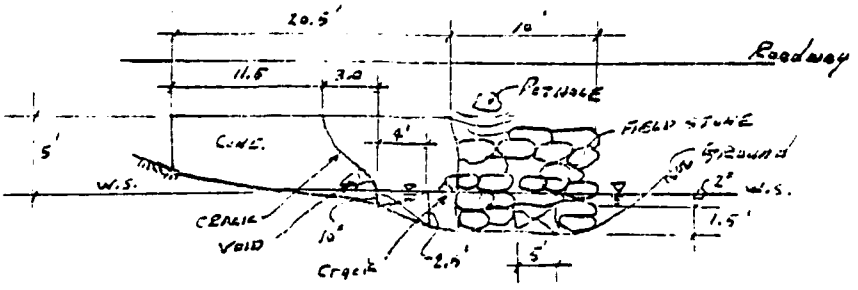


ELEVATION

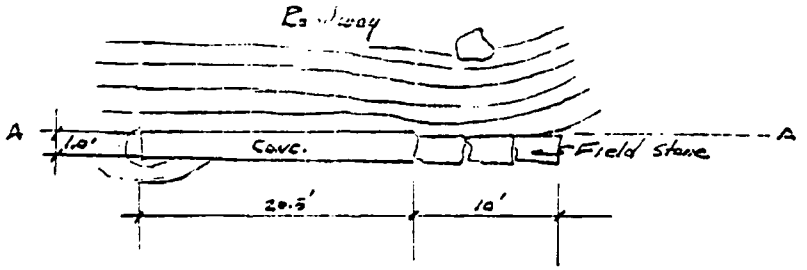
Upstream Headwall

Corps of Engineers
Chaffin Pond Dam
Outlet Facility

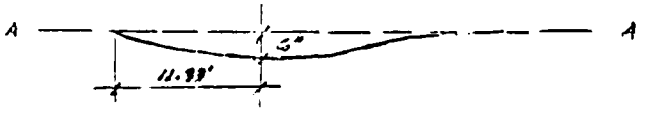
11/16/78
RPH



ELEVATION



PLAN



OFFSETS

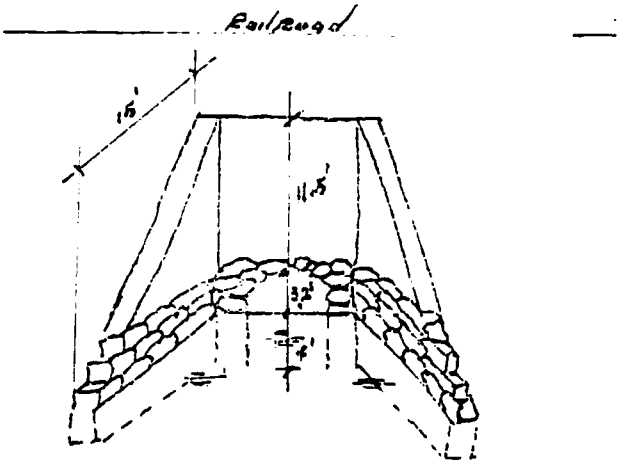
DOWNSTREAM HEADWALL

DAMP DRESSER & MYERS
Environmental Engineers
Boston, Mass.

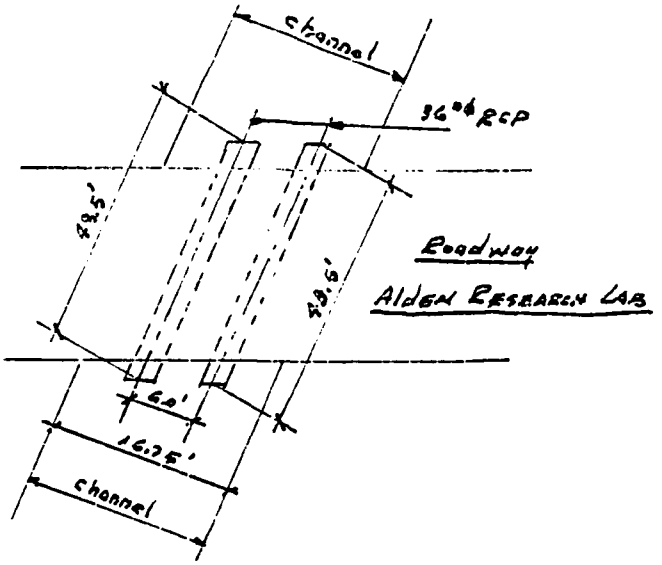
JOB Corps of Engineers
SUBJECT Chaffin Pond Dam
Down Stream Controls

CHECKED BY

DATE 11/16/78
COMPUTED BY RPH

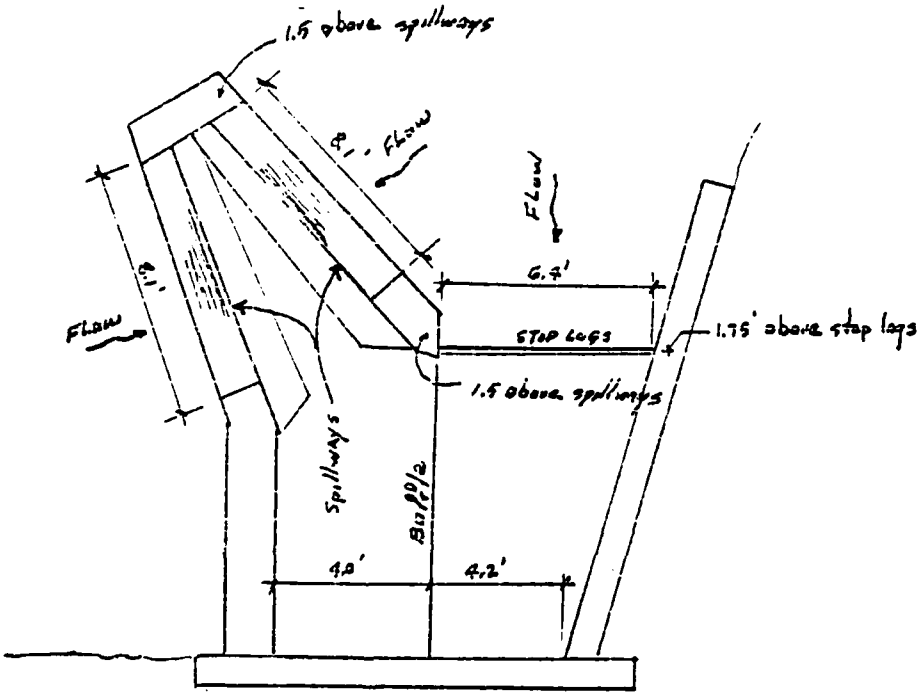


ELEVATION



PLAN

Pond

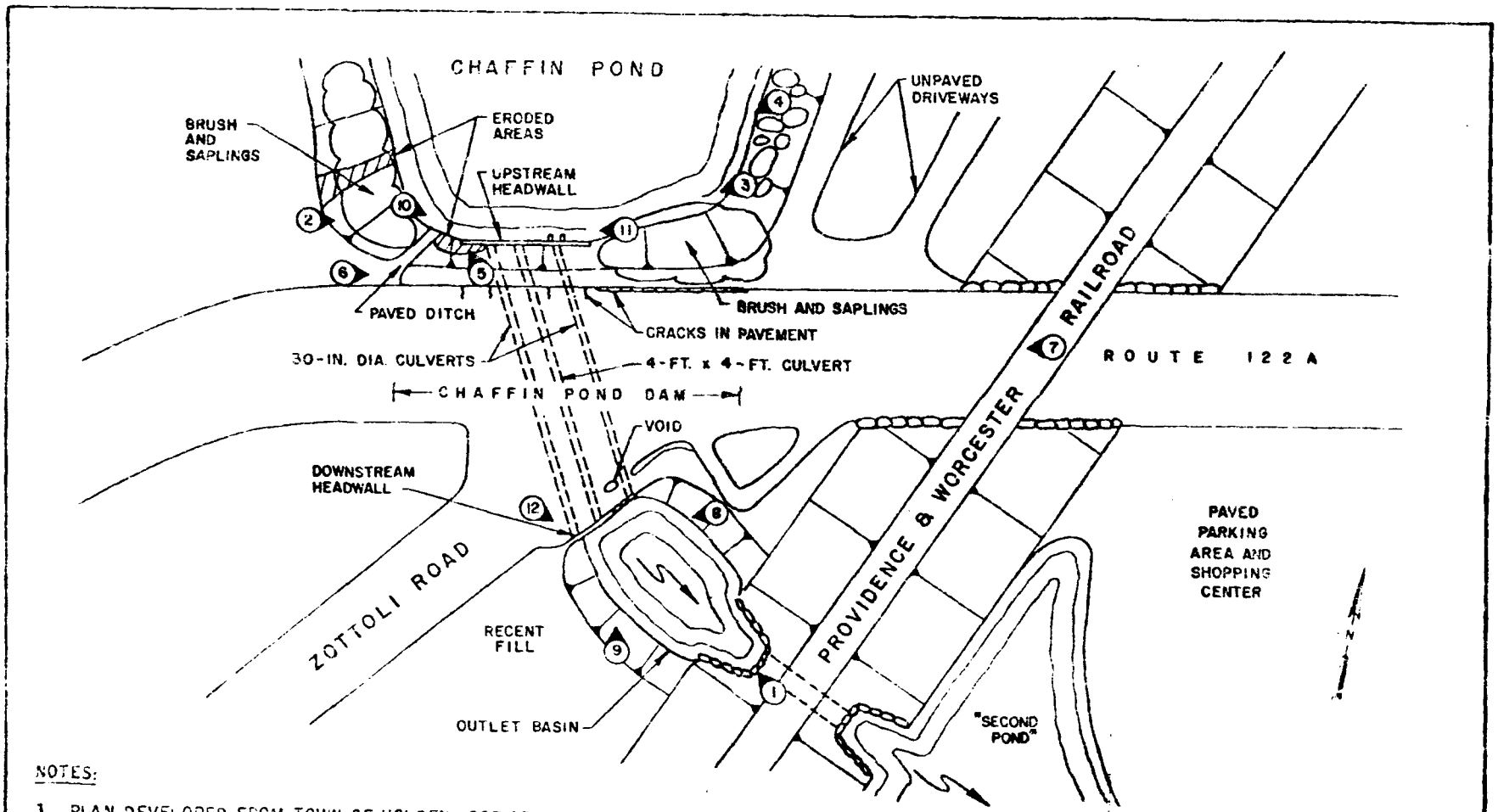


Roadway

ALDEN RESEARCH LAB

PLAN

APPENDIX C - PHOTOGRAPHS



NOTES:

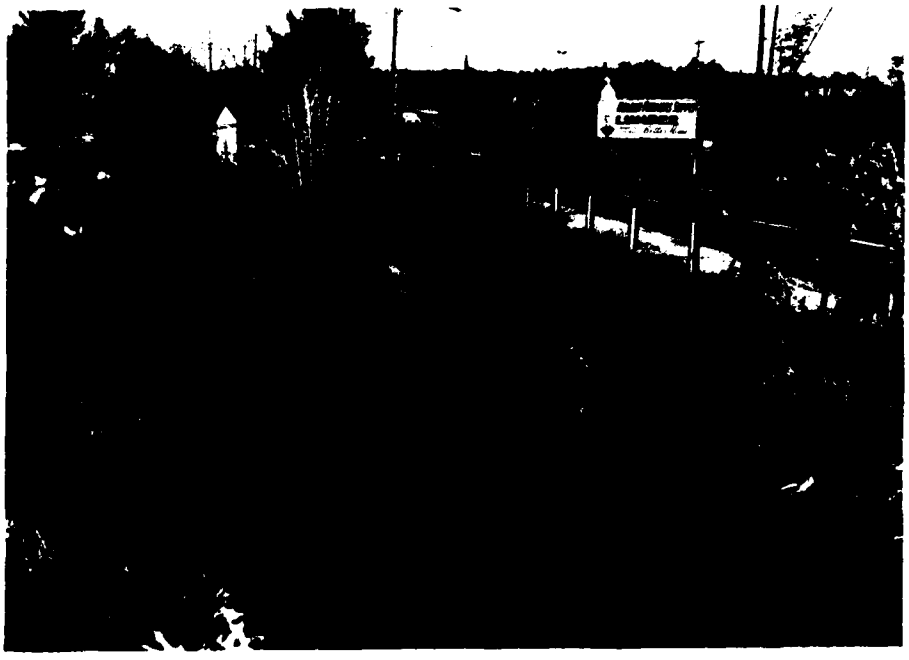
1. PLAN DEVELOPED FROM TOWN OF HOLDEN, OFFICE OF ASSESSOR, MAP NO. 199, DATED 3 JUNE 1966, AND FIELD OBSERVATIONS ON 16 NOVEMBER 1978
2. PHOTO NO. 13 TAKEN AT THE "SECOND POND" OUTLET FACES NORTH AND LOOKS TOWARD HIGGINS STREET NEAR ALDEN

LEGEND

(5) PHOTO NO. AND DIRECTION OF VIEW

Chaffin Pond Dam
Holden, MA

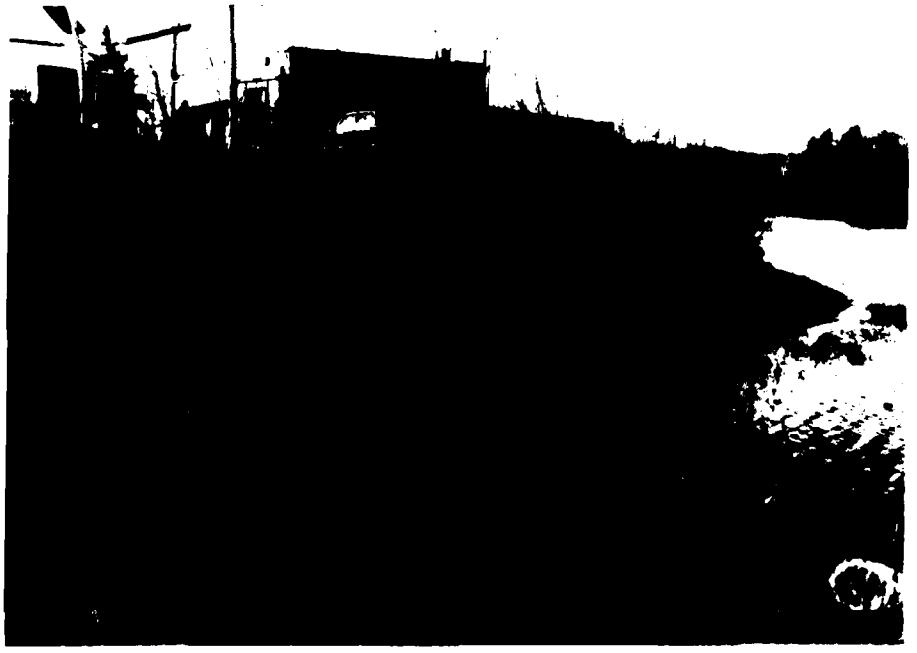
SITE PLAN



2. Upstream view of dam, left side

3. Embankment left of upstream headwall

4. Upstream view of dam, right side



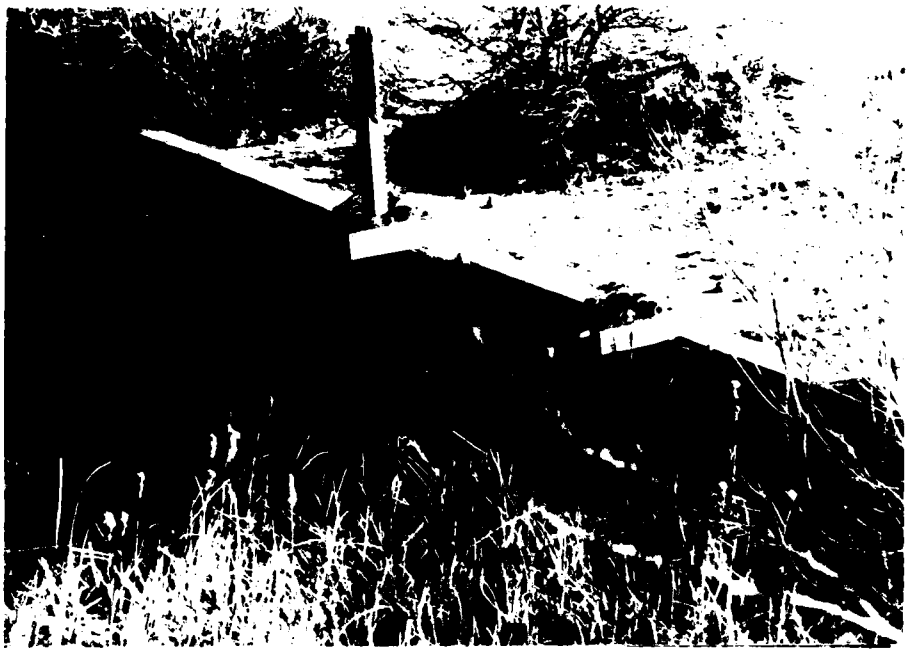
5. Eroding fill right of upstream headwall

6. Upstream side of crest, Route 122A

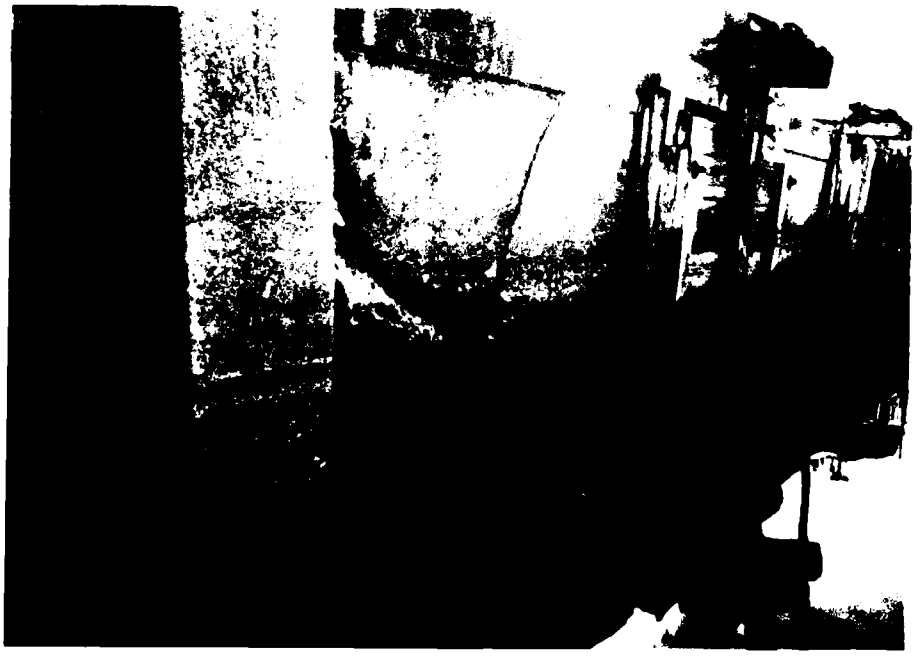
7. Crest of dam from top of railroad embankment underpass

8. Cracked downstream headwall

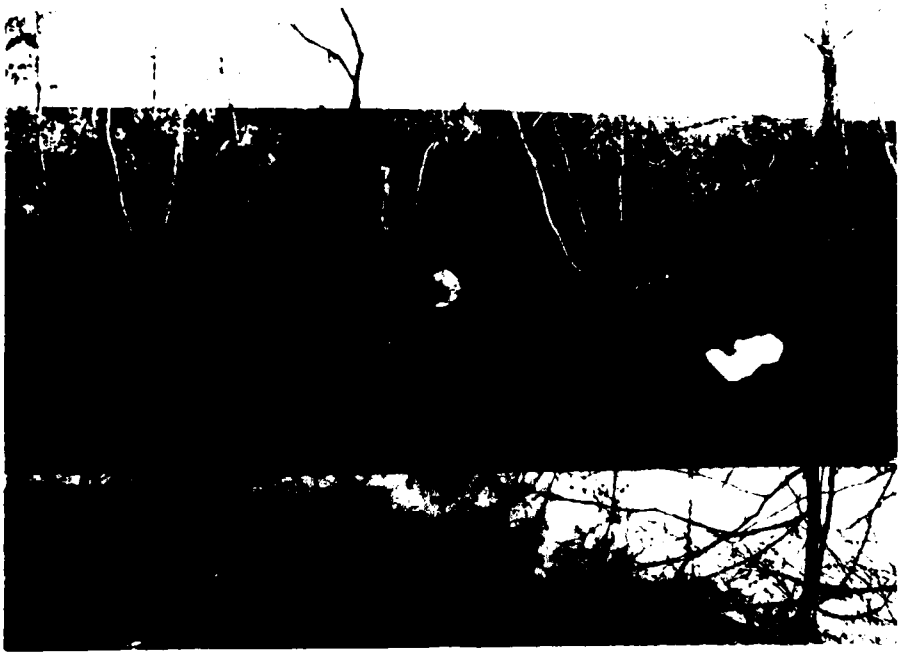
9. Void beneath pavement and fieldstone portion of downstream headwall



10. Upstream headwall and culvert entrance controls



11. Closeup of damaged upstream headwall and wooden gates



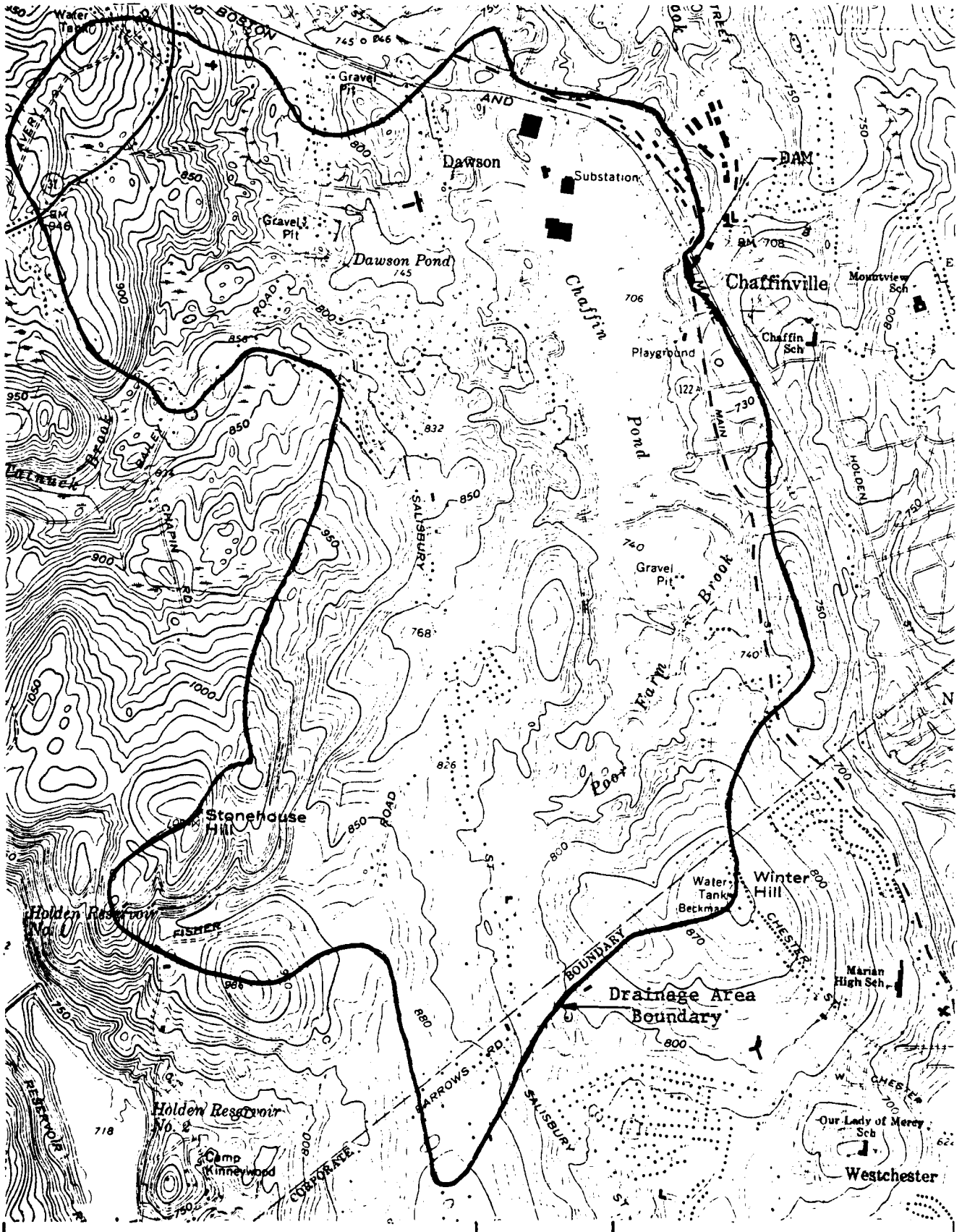
12. Outlet pool downstream of dam and arch culvert through railroad embankment to a second pond

13. Alden Research Laboratory outlet facilities at second pond, adjacent to Shrewsbury Street

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Page

Computations



CAMP DRESSER & McKEE Inc.
Consulting Engineers
Boston, Mass.

N

CHAFFIN POND DAM
DRAINAGE AREA

SCALE: 1:24,000

D-1

CAMP DRESSER & McKEE
Environmental Engineers
Boston Mass

CLIENT H x A
PROJECT COE Dam Inspection
DETAIL Chiffon Pond Dam

JOB NO 561-B-Rt-
DATE CHECKED 1/31/79
CHECKED BY AHG

PAGE 1
DATE 1/9/79
COMPUTED BY K. S. Chin

Size Classification

Maximum height : 11-ft. < 40
Maximum Storage : 1450 acre-ft > 1000
} INTERMEDIATE

Hazard Potential

Potential hazard appears to be "low" as failure discharge would be controlled at the nearby downstream facilities. The only damage would probably be the interruption of traffic on Route 122A.

Test Flood Flow :

Intermediate size & Low hazard : $Q = \frac{1}{4} \sim \frac{1}{2}$ PMF

Considering the Maximum storage size which is near the lower limit of the intermediate size category and the low hazard condition, a test flood of $\frac{1}{4}$ PMF was adopted for this study.

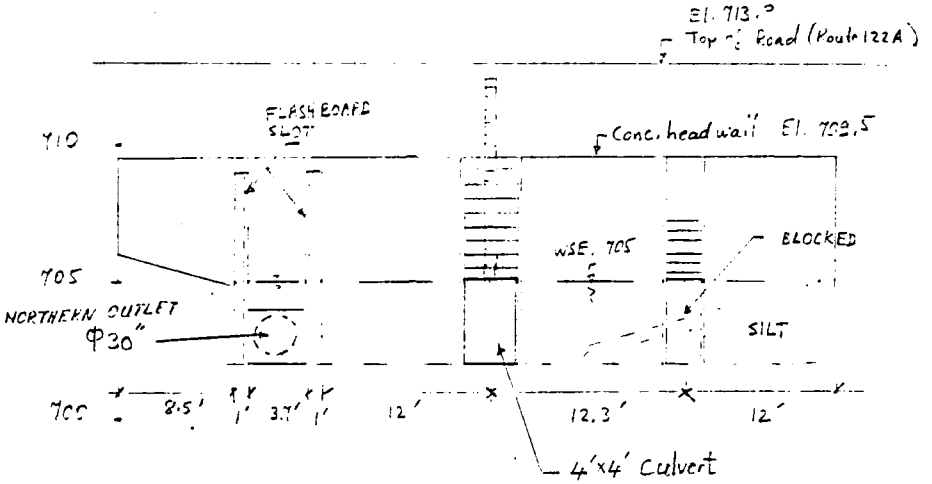
Drainage Area = 2280 acres ≅ 3.6 sqmi

PMF = 1950 × 3.6 = 7020 cfs.

$\frac{1}{4}$ PMF = 1750 cfs. = TEST FLOOD INFLOW

Surcharge - Storage Routing :

No spillway. Assume the northern and the center outlets at the dam are working; and the WSE in the second pond was lowered below el. 703.



OUTLET WORKS

$D_1 = 2.5$ ft $A_1 = 5$ sq ft $R_1 = 0.63$ $R_1^{2/3} = 0.73$ $n = 0.015$

$Q_1 = \frac{1.49}{0.015} \times 5 \times 0.73 \times S_1^{1/2} = 361\, S_1^{1/2}$ $L = 110'$ $S_1 = \frac{\Delta h - \Delta h_{v_1}}{110}$

$Q_2 = \frac{1.49}{0.015} \times 16 \times 1 \times S_2^{1/2} = 1584\, S_2^{1/2}$ $S_2 = \frac{\Delta h - \Delta h_{v_2}}{110}$

WSE @ Chaffin Pond (Ft)	q_1	q_2	Total cfs	Discharge* acre-ft/hr
706.3	50	140	190	16
707.3	60	165	225	19
708	70	190	260	22
708.8	80	220	300	25

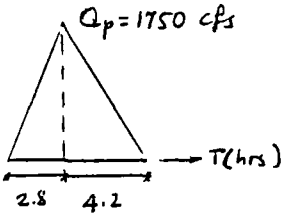
* Assuming that the outlets at the second pond would be opened up to permit the flow pass through the tunnel without a backup.

Volume of the water from the test flood storm:

T_p = 2.8 hrs, estimated with SCS method.

Assume $T = 2.5\ T_p$ for runoff.

V = 506 acre-ft. (Volume of runoff)



Normal Pond Vol. 210 ac-ft @ El. 705.
Total Volume: 716 ac-ft
Outflow during storm: -36 "
Total Remaining Vol. 680 " " →

WSE for Res. Vol. of 680 ac-ft → 708.8 ft. (see area-Volume curve)

This indicates that the road would not be overtopped, but a significant amount of surcharge will take place in the pond.

Time req'd to empty reservoir to normal volume:

$$t = \frac{506 - 36}{20} \simeq 24 \text{ hrs}$$ if the average outlet capacity is 20 ac-ft per hour. This would require operation of the both outlets which were mentioned in page 2.

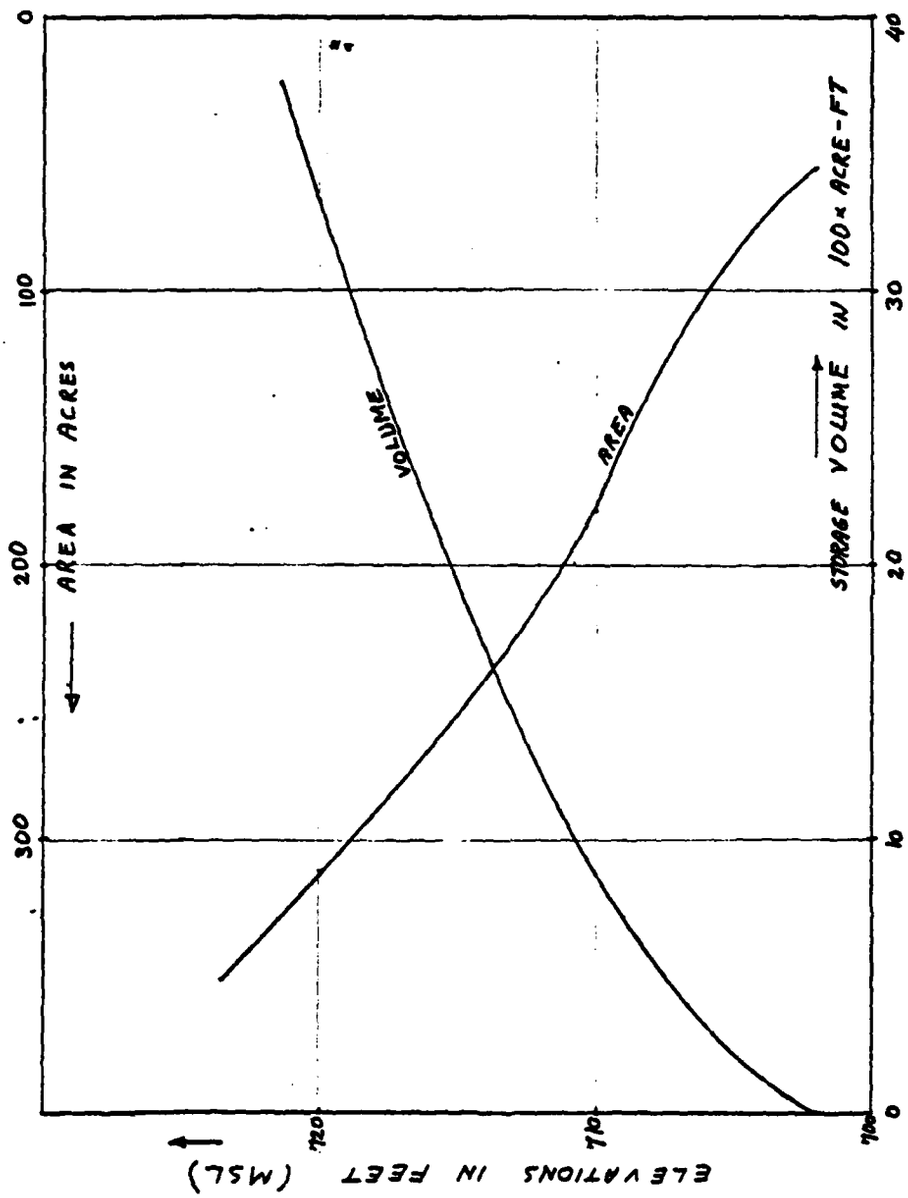
Consequently, it is recommended that at least two outlets underneath the dam should be maintained in good condition. Timely operation of the outlet facilities at the second pond is also important for lowering the water level to provide an adequate hydraulic gradeline for the flood outflows through the tunnel underneath the railroad.

CAMP DRESSER & McKEE
Environmental Engineers
Boston, Mass.

CLIENT H&A
PROJECT COE Dam Inspection
DETAIL Chaffin Pond Dam

JOB NO. 561-9-Rt-11
DATE CHECKED 1/10/79
CHECKED BY AUG

PAGE 4
DATE 1/2/79
COMPUTED BY K.S. Chin



Dam Failure Analysis

Assumed W.S. Elev. @ time of failure : 713.0 (top of Dam)

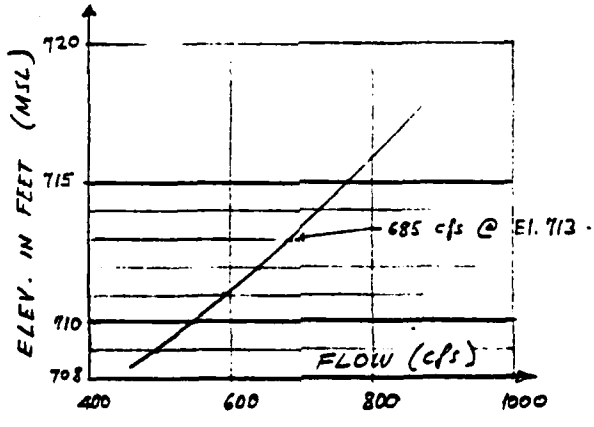
S = Reservoir Storage : 1450 acre-ft.

$Q_{p_1} = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2}$ $\quad W_b = 100\text{-ft} \times 0.4 = 40\text{-ft}$
(Dam crest length ≅ 150-ft)

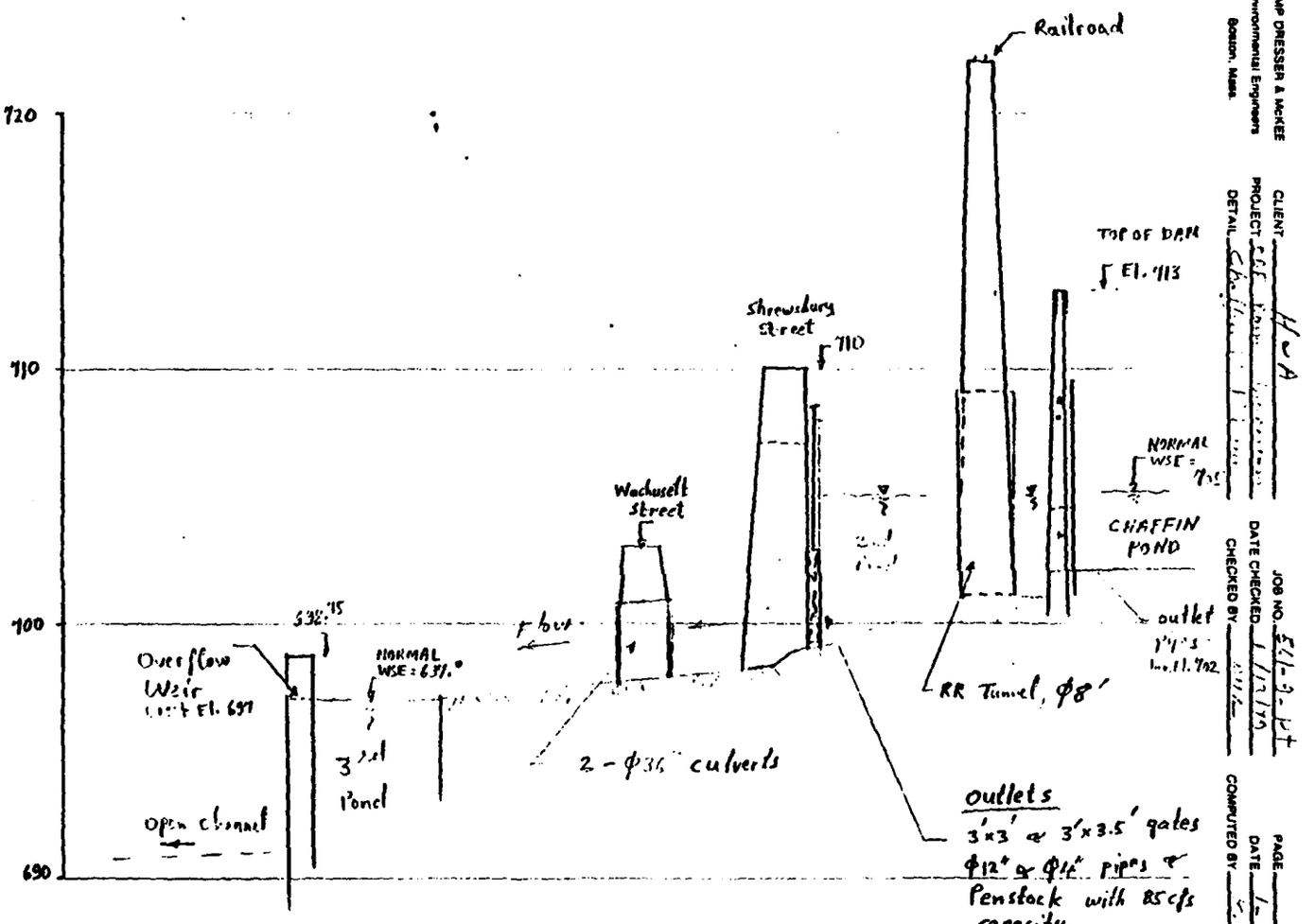
$Y_o = 713 - 702.5 = 10.5$ -ft.

$Q_{p_1} \cong 2300$ cfs. This is a theoretical discharge as the flow at the downstream area is restricted at a short distance from dam, by the railroad embankment; by the local topography; and by the outlet controls on the second pond. A profile of the Chaffin Pond outlet and the other downstream facilities are shown in Page 6.

When the upstream water surface elevation is at 713 the tunnel would pass a flow of about 685 cfs. A stage-capacity curve for the tunnel is shown below:



The maximum capacities of the other downstream facilities are less than 685 cfs; because of this the second pond would be subject to a surcharge after the failure.



PROFILE OF CHAFFIN POND AND DOWNSTR. FACILITIES

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CLIENT
PROJECT
DETAIL
DATE CHECKED
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JOB NO.
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PAGE
DATE

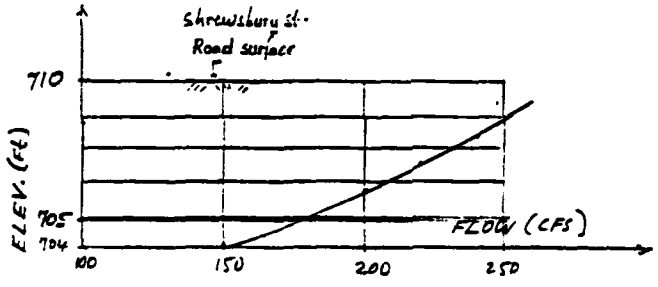
D-7

The water level from the failure would subside gradually with controlled flows through the second pond outlet facilities, which, in turn, may be effected by capacities of the downstream channel and culverts and the overflow weirs of the Third Pond. The estimated independent capacities of the facilities are shown below:

1. Outlet Facilities of the Second Pond

2 - Sluice gates - open =	250 cfs
Penstock to Alden Lab. (as reported)	85 "
D = 12 - in outlet	11 "
D = 4 - in "	1 "
Total	347 "

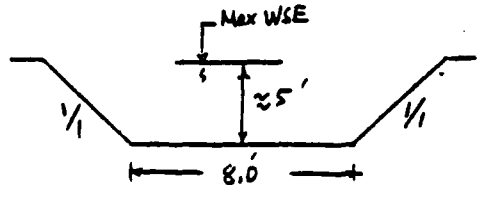
Capacity of the 2 sluice gates in relation to WSE in the 2nd pond is shown with the following curve:



2. Capacity of the open channel downstream of the second pond

$$Q_{max} = \frac{1.49}{0.025} \cdot 65 \cdot 2.06 \sqrt{0.003} =$$

$$= 440 \text{ cfs}.$$



3- Capacity of the culverts underneath Wachusett st:

$2 - \phi\ 36''$ $\quad n = 0.015$ $\quad L = 48.5$ $\quad A_1 = 7.07\ \square'$

$Q_1 = 58\sqrt{s}$ $\quad$ Assume 2.1-ft = Δh (up to road surface)

$s = \frac{2.1 - \Delta h_v}{48.5}$

Try $Q_1 = 60$ cfs $\rightarrow$ $V_1 = \frac{60}{7.07} = 8.49$ fps $\quad 1.5\frac{V_1^2}{2g} = 1.68$

$s = \frac{2.10 - 1.68}{48.5} = 0.087$ $\quad \sqrt{s} = 0.093 \longrightarrow Q_1 = 54$ cfs ≈ 60 cfs.

2 culverts : $2 \times 60 = 120$ cfs.

The culverts would create a bottleneck in the channel. However, the flow over the road or on the channel banks would quickly reach to either the 3rd pond or to its outlet channel which winds through Alden Lab. ~~facilities~~ structures.

4- Capacity of the spillway at the Third Pond:

Overflow Weir (1) : El. at crest: 697.6 (estimated from USGS)
$L = 6.4$ ft

Overflow Weir (2) & (3) : Crest El. 697.1
$L = 8.1$-ft, each.

$\Sigma Q = 20.5\ H_1^{3/2} + (H_1 - 0.1)^{3/2} \cdot 56.7$

El. at top of the sidewall = 698.75 $\quad H_1 = 1.75'$

$Q_{max} = 48.0 + 120 = 168$ cfs.

A quick routing of the failure volume through the system, based on the above findings, showed that it would approximately take about 40 hours to discharge the excess water (above elev. 705) out of the system.
Conclusion: In the event of a failure at the Chaffin Pond dam the traffic would be interrupted on Route 122A; excess water would not create a ~~flow~~ flooding hazard because of the downstream restrictions and controls.

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
MA	621	NED	MA	027	02				CHAFFIN POND DAM	4220.1	7150.3	20	FEB	79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	CHAFFIN POND

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	05	POOR FARM BROOK	HOLDEN	0	13629

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
PGHECT	1900	D	11	11	1450	310	NED	N	N	N	N	07MAR79

(28) REMARKS
21=ROADWAY EMBANKMENT 23=HYDRAULIC LAB SUPPLY

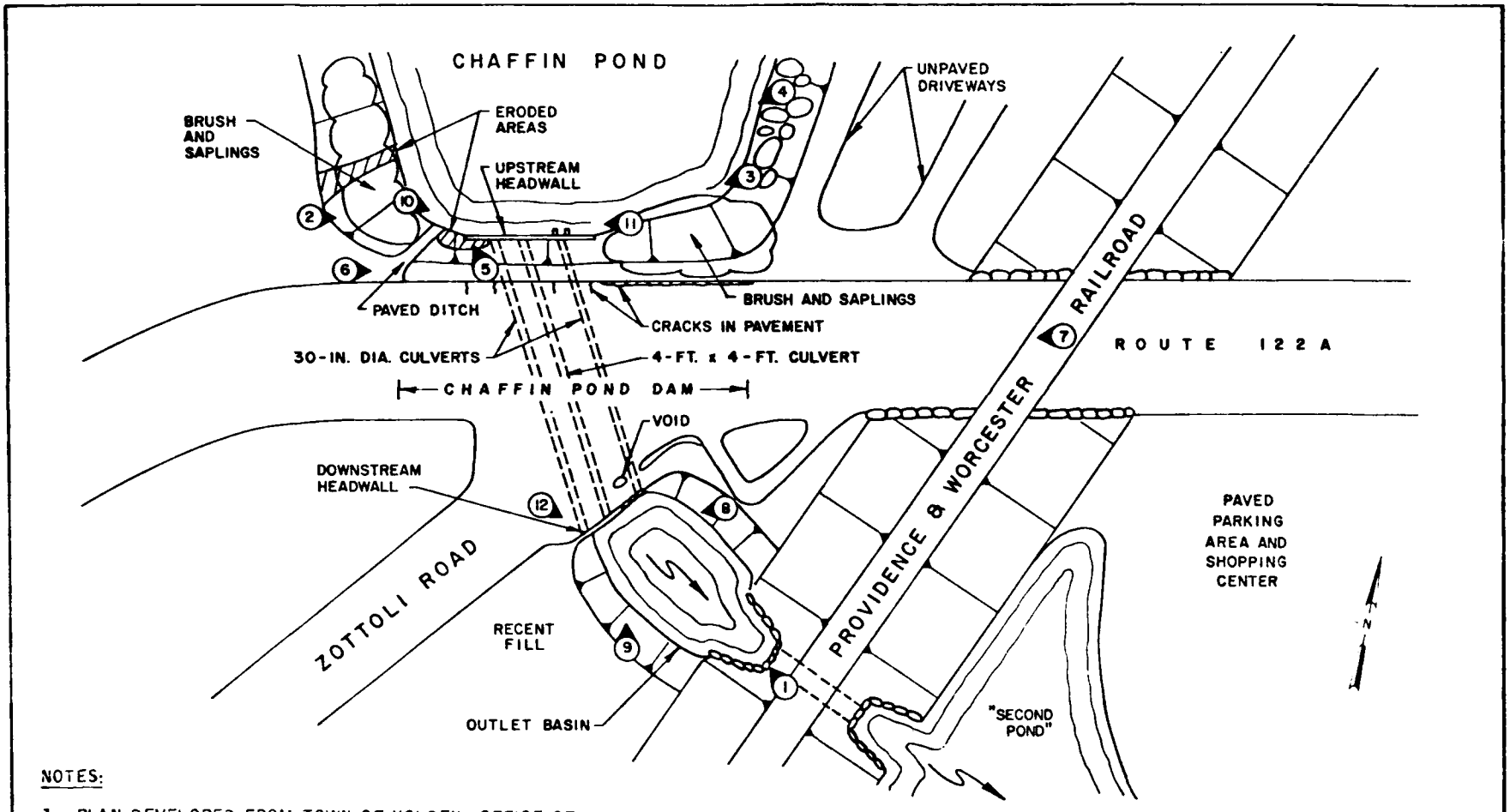
(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) TYPE	(32) WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) PROPOSED (MW)	(37) NAVIGATION LOCKS NO.	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
3	155	N			500											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
WORCESTER POLY TECH INST	UNKNOWN	UNKNOWN

(49) REGULATORY AGENCY DESIGN	(50) CONSTRUCTION	(51) OPERATION	(52) MAINTENANCE
NONE	NONE	NONE	MA DPW

(53) INSPECTION BY	(54) INSPECTION DATE DAY	MO	YR	(55) AUTHORITY FOR INSPECTION
HALEY + ALDRICH, INC.	16	NOV	78	PUBLIC LAW 92-367

(56) REMARKS
46=ONLY OWNS UPSTREAM HEADGATE, OTHER OWNERS FOR REST OF DAM



NOTES:

1. PLAN DEVELOPED FROM TOWN OF HOLDEN, OFFICE OF ASSESSOR, MAP NO. 199, DATED 3 JUNE 1966, AND FIELD OBSERVATIONS ON 16 NOVEMBER 1978
2. PHOTO NO. 13 TAKEN AT THE "SECOND POND" OUTLET FACILITIES ADJACENT TO SHREWSBURY STREET NEAR ALDEN RESEARCH LABORATORY.

LEGEND

(6) PHOTO NO. AND DIRECTION OF VIEW.

Chaffin Pond Dam
Holden, MA

SITE PLAN SKETCH

Scale: 1"=40' February 1979

HALEY & ALDRICH, INC.